

PATENT SPECIFICATION

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(54) PLATE-TYPE HEAT EXCHANGER

(71) We, PRZEDSIĘBIORSTWO
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 URZĄDZEN CHŁODNICZYCH "COCH",
 of UL. Dzierzynskiego 116, Krakow, Poland,
 a Company organised and existing under the
 laws of Poland, do hereby declare the inven-
 tion, for which we pray that a patent may
 be granted to us, and the method by which
 it is to be performed, to be particularly des-
 cribed in and by the following statement:—
 The invention relates to a plate-type heat
 exchanger for the exchange of heat between
 two fluid media and suitable for operation
 under high pressures and at high pressure
 differences between the media.
 There are known plate-type heat ex-
 changers built up of flat plates of various
 shapes, provided with distance pieces. All the
 elements are rigidly fitted with each other
 forming a compact assembly placed in a
 housing provided with inlet and outlet stub
 pipes for the heat exchanging media flowing
 through the space between the plates.
 There are also known plate-type heat ex-
 changers without any housing, made of plates
 shaped as round, oval or square trays with
 rounded corners. These plates are tightly
 joined together along their adjacent edges, and
 are provided with ports and passage stub
 pipes enabling the heat exchanging media to
 flow between said plates, each of said media
 flowing through every other interplate space.
 A disadvantage of known plate-type heat
 exchangers consists in that they can be em-
 ployed only in heat exchange processes where
 the pressures of said media are not consider-
 able. High working pressures cause buckling
 of the plate elements, and leakages of welded
 or glued joints. This limits considerably the
 use of said exchangers for working under
 high thermal and mechanical loads. To
 counteract this unfavourable behaviour by in-
 creasing the thickness of plates and jackets,
 or employing stiffenings, leads to an increase
 of the weight of the exchanger, which is
 economically undesirable.
 An object of the present invention is to
 provide a design of the heat exchanger show-

ing the energetic advantages of plate-type ex-
 changers, and the high strength of jacket-and-
 pipe exchangers, and offering the possibility
 of easy changing of the heat exchange area.

According to the invention we provide a
 plate-type heat exchanger for exchanging heat
 between two fluid media, which exchanger
 is composed of a plate assembly in which
 the plates are connected fluid-tightly with one
 another and form two parallel ducts flowed
 through by the heat exchanging media, which
 assembly is enclosed in a fluid-tight jacket
 with an internal space, one of the ducts
 formed between the plates of the assembly
 being connected at one end with the internal
 space of the jacket.

The plate assembly is preferably composed
 of two types of plates symmetrical about two
 mutually perpendicular respective axes,
 arranged alternately and each provided with
 two through-openings, one of which is fitted
 with a neck. Said through-openings in both
 types of plates are located offset from the
 main axes of the plates at equal distances
 from the centres of the plates, and the angles
 between radii, on which the axes of open-
 ings of neighbouring plates are positioned,
 are different, the sum thereof however being
 equal to 180°.

Each type of plates carries, on its surface,
 distance pieces, arranged on diameters not
 covering mutually.

The advantage of the exchanger according
 to the invention is its simple and compact
 structure and favourable energetic charac-
 teristics. The plates of the heat exchanger
 are unified thus can be manufactured by
 means of a single device. Moreover, accord-
 ing to the requirements, the plates may be
 assembled in a set having a determined heat
 exchange area.

The fact that one flow-through duct with-
 in the plate assembly leads to the internal
 space of the jacket makes it possible to
 eliminate pressure loading on said assembly
 completely or partially. In the case of equal
 pressures of the heat exchanging media the
 plate assembly is free of pressure loading.

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5 The reduction or elimination of pressure load acting on the plates permits operation of the heat exchanger under high working pressures limited only by the strength of the outer jacket

The plate assembly has very low thermal inertia, which is of importance in the case of processes with automatic regulation.

10 An exemplary embodiment of the invention is explained with reference to the accompanying drawings, wherein:—

Figure 1 is a longitudinal sectional view of a heat exchanger on line A—A in Figure 2;

15 Figure 2 is a cross-sectional view on line B—B in Figure 1;

Figure 3 is a plan view of one type of plate of the heat exchanger;

20 Figure 4 is a cross-sectional view on line C—C in Figure 3; and

Figure 5 is a plan view of the other type of plate of the exchanger.

25 The exchanger is composed of a jacket 1 closed at one end by a flanked flat plate 2, and at the other end by a dished plate 3. Within the jacket 1 a plate assembly 4 is mounted on supports 5 welded to the plate 3.

30 The plate assembly 4 is composed of alternately arranged plates 6 (Figures 3 and 4) and 7 (Figure 5). Said plates are in the shape of round trays each with a frusto-conical flange 6A and are provided with two through-openings each, namely an opening 8 without a neck, and an opening 9 provided with a neck 10. Said through-openings are offset from the main axes of the plates 6 and 7 and are at equal distances from the plate centres.

40 The angles between radii, on which the axes of the opening 8 and 9 of consecutive plates 6 and 7 are located, are different but their sum on two adjacent plates 6, 7 equals 180°.

45 The plates 6 and 7 are mounted together in the following way (looking onto the lower plates after Figure 1):— The opening 8 of the plate 6 is connected with the inlet stub pipe 20 of the medium *b*. The opening 8 of plate 7 is fitted over the neck 10 of the plate 6. The opening 9 of the plate 7, provided with the neck 10, is inserted into the opening 8 (not shown in the drawing) of the plate 6 next above, the opening 9 of the latter plate 6, provided with the neck 10, is connected with the opening 8 of the plate 7 next above, and so on. Thus the plates 6 and 7 alternate. Successive plates 6 are turned in the plane of the plate relative to each other by 180°, and successive plates 7 are also turned in the plane of the plate relative to each other by 180°.

60 The plates 6 and 7 are fluid-tightly welded with one another along their borders and at the contact edges of the openings 8 with the necks 10. At the ends of the plate

assembly 4 flat plates 12 and 13 are welded on as well as reinforcing rings 14 and 15 to which flexible spacing elements 11 are fixed. The latter are in the form of strips or slats and interconnect the end plates 12, 13. Their function is to ensure proper assembly of the plates and to isolate the inlet and outlet pipes 17, 18, 20 from lateral displacements of the plate assembly.

70 The plates 6 and 7 are provided with extruded conical spacing elements 16 with the high equal to the spacing of said plates within the assembly 4. Said elements 16 are arranged on diameters not covering by one another.

75 Thus the plate assembly 4 defines two separate parallel ducts for flow of the media *a* and *b*, the duct for whereby the one thereof is from one end medium *a* being connected with the internal space of the jacket 1.

85 The heat exchanger is provided with connector pipes 17, 18, 19 and 20 serving as inlets and outlets for the media *a* and *b*. Pipes 17, 18, 20 communicate directly with the plate assembly whereas pipe 19 communicates with the internal space of the jacket.

90 The heat exchanging media flow through the plate assembly 4 in the following way (Figure 1):— the medium *b* supplied through the connector pipe 20 flows along the lowest plate 6 to the opening 9 (not shown in Figure 1) of the plate 7 next above, and flows through the neck 10 of this plate 7 into the next plate 6, therefrom through the opening 9 with neck 10 of the next plate 7 into the subsequent plate 6, and so on to the outlet connector 17.

95 Similarly, the medium *a* flows through the plate 7 from connector 18 to connector 19 and simultaneously fills the space between the assembly 4 and the jacket 1.

100 Owing to the spacing elements 16 in the plates 6 and 7 the flow of the media *a* and *b* becomes turbulent, which increases the rate of heat exchange. This process gets intensified additionally owing to the arrangement of through-openings 8 and 9 in the plates 6 and 7, which forces the media *a* and *b* to flow along the surface of said plates.

105 The maximum pressure acting on the plates of the plate assembly 4 equals the pressure difference of media *a* and *b*, outside this assembly, however, the pressure of medium *a* is present. If the pressures of media *a* and *b* are equal, the plate assembly 4 is released completely from pressure loading.

110 The heat exchanger can operate with media of various viscosities and at a wide range of working pressures.

115 The heat exchanger can operate in horizontal or in vertical position.

WHAT WE CLAIM IS:—

1. A plate-type heat exchanger for ex-

changing heat between two fluid media, which
exchanger is composed of a plate assembly in
which the plates are connected fluid-tightly
with one another and form two parallel ducts
5 flowed through by the heat exchanging media,
which assembly is enclosed in a fluid-tight
jacket with an internal space, one of the ducts
formed between the plates of the assembly
being connected at one end with the internal
10 space of the jacket.

2. A heat exchanger according to claim 1,
in which the plate assembly is built up from
two types of plates respectively symmetrical
about two mutually perpendicular axes and
15 arranged alternately, each plate being pro-
vided with two through-openings one of

which is provided with a neck, said open-
ing in both types of plates being offset from
the main axes of the plates but at equal dis-
tance from the plate centre, and the angles 20
between radii on which the axes of said
openings on neighbouring plates are situated
being different and equal in sum to 180°.

3. A heat exchanger according to claim 2,
in which the plates have on their surfaces 25
spacing elements positioned on mutually not
covering diameters on every one plate.

4. A heat exchanger substantially as herein
described with reference to the accompany-
ing drawings. 30

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COMPLETE SPECIFICATION

3 SHEETS

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the Original on a reduced scale
Sheet 1

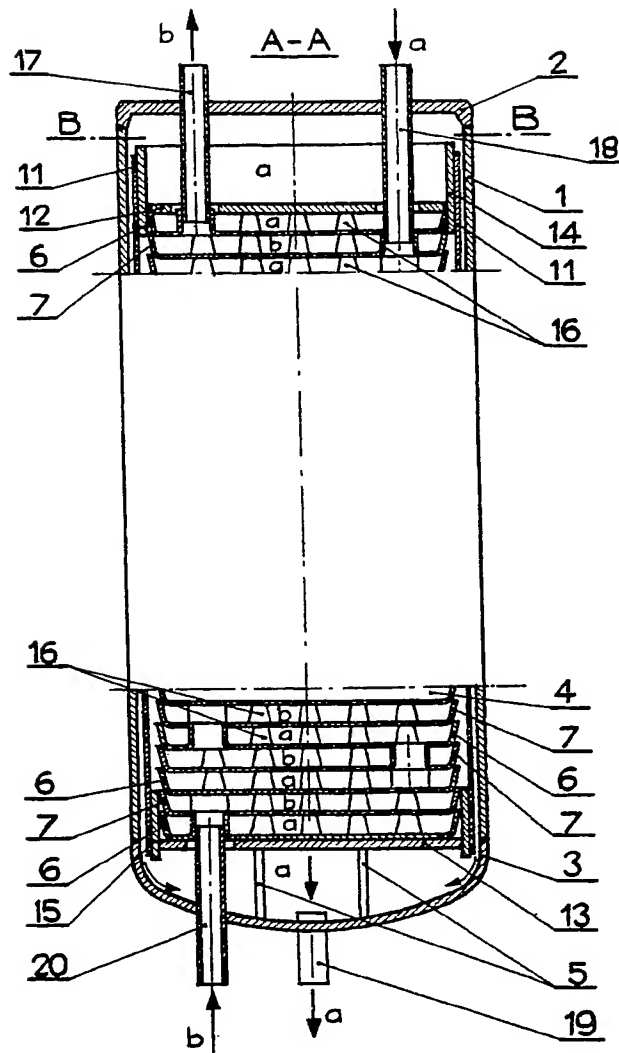


Fig. 1

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Sheet 2

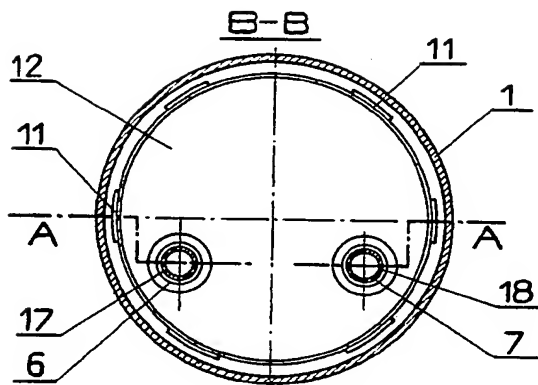


Fig. 2

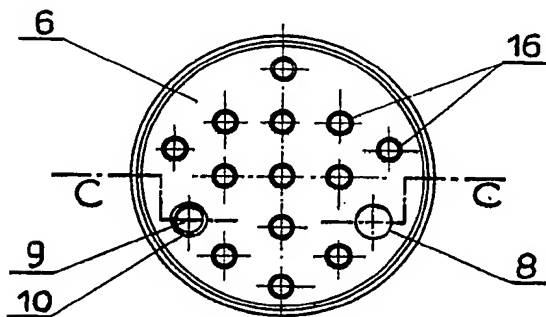


Fig. 3

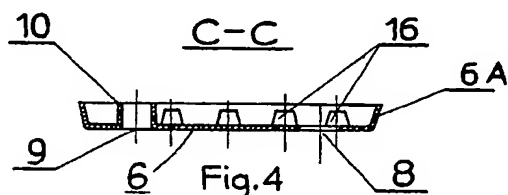


Fig. 4

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Sheet 3

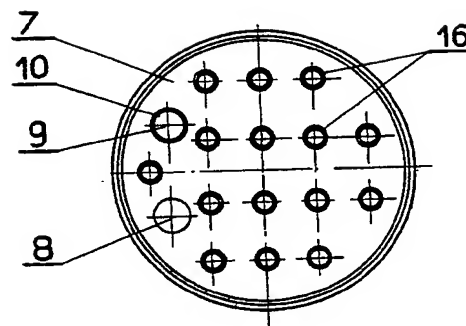


Fig. 5

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